Lesson 53 - Solar Energy And Your Health

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1. Solar Energy

1.1 What Is Solar Power?

The sun is expected to emit radiant energy for another four billion years, the only perpetually renewable energy source for our planet. Obviously, it is time to learn how to use the massive amounts of energy the sun gives us each day. Three processes by which the sun's radiation can be used are *heliochemical* (photosynthesis, photography), *helioelectrical* (manmade devices that convert solar radiation into electricity), and *heliothermal* (devices that absorb solar radiation on blackened surfaces and convert it to heat).

All energy on earth originally came from the sun. All of our hydrocarbon fuels such as coal, oil, and natural gas were originally produced by the action of sunlight on vegetation.

Light is a form of electromagnetic energy. Energy is the capacity to do work, and power is the rate at which energy is generated or used (measured in watts or kilowatts). The amount of power we can get from any solar device depends on the amount of sunlight it intercepts and on the efficiency of the energy conversion device. Solar energy intercepted by an area the size of a small tennis court would supply the energy needs of an average household. The radiant energy in sunlight must be converted into some form of energy that is easier to use, such as electricity—the solar cell is just such a device.

The photovoltaic effect, where electricity is produced when certain materials are illuminated, was first noted in 1839, and the photovoltaic effect, where electricity is produced when certain materials are illuminated, was first noted in 1839, and the photovoltaic cell is probably the first solid-state electronic device ever invented. Its use has been slow because of the abundance of hydrocarbon fuels like coal, oil, and natural gas. Photovoltaics were first used in selenium cells to measure light levels (as with the light meter used in photography). The space program uses photovoltaic cells because conventional batteries will run down, but solar cells will continue to deliver electric power as long as sunlight is available.

1.2 Advantages of Using Solar Power

The basic reason for using solar energy is that it is a renewable, limitless energy source that promises freedom from dependency on nonrenewable energy sources, thus freeing humankind from the threat of war over dwindling natural resources.

Solar power is clean, nonpolluting, and safe. Once the basic systems are installed, the sun is free; and since power is produced locally, on the spot where it is to be used, transportation of fuels and distribution of power aren't necessary. Solar electricity can be brought to remote locations that are too far away for bringing power lines, for example. Solar research can be carried out in small laboratories with inexpensive equipment.

Solar energy usage will create jobs—about four times as many as nuclear power. It is labor-intensive, that is, about half the money that goes to building a solar space or water-heating system goes to paying the wages of the people building or installing it. A solar-based economy would put more people to work than a fossil/nuclear one. (It also employ's people from a wider range of abilities, whereas nuclear power plants, aside from preliminary construction workers, use mostly professionals. Most jobs at nuclear plants will be for security personnel.) Solar power is community-based, but nuclear power is centralized and monopolized by certain monied interests. Tax credits can be received for certain home-improvement and energy conservation installations.

1.3 History of Solar Power

The concepts behind solar energy use are not new, by any means. Legend has it that in 212 B.C. Archimedes set fire to an attacking Roman fleet by turning a "burning glass" composed of small, hinged square mirrors so as to reflect concentrated sunlight onto the ships. For years scientists argued about whether this was myth or fact, but in 1747 a Frenchman proved that it could have been done by burning wood from a distance of 200 feet with an array of 168 small flat mirrors, and then melted lead at 130 feet and silver at 60 feet. In the same century, an optician in France built polished iron solar furnaces that could smelt iron, copper, and other metals. Another investor used two lens to achieve a temperature close to 1750° Fahrenheit—far beyond any temperature attained by man up to this time.

In the 1800s came many models of solar-powered engines and solar steam engines. In 1871, a solar still in Chile provided 6,000 gallons of pure water a day for forty years. In 1880, a solar engine was built in France that ran a printing press.

Of course, foods have been sun-dried for ages, using solar power *without* the need for technology. In the early 1900s, solar ovens appeared.

Solar water heaters were known in southern California and other states in the 1920s and 30s. After World War II, solar sciences flourished in Europe and a boom in solar water heaters began in Japan and Israel. Heaters were installed by the 100,000's in Japan.

Here in America, the military picked up interest in solar power. The navy wanted solar battery power supplies for buoys and other installations. The Air Force had small solar-powered radio transceivers for aviators' survival kits. The Army used solar panels to transmit radio signals and put smaller units in helmet radios for soldiers.

These are but a *few* of the many experiments in solar power undertaken through the centuries, and one would need to read a whole book to go into greater depth. The point is, that many inventors have long trusted in the power of the sun, and their greatest obstacle has probably always been the apathetic lack of interest by their fellow men in using the sun's power. In fact, there is an interesting analogy that serves as a parallel to the solar/nuclear industry. When Thomas Edison was first working on his experimental light bulb, the gas company did all it could to discredit this inventor calling his work foolishness. They wanted, of course, to preserve their energy monopoly as gas suppliers to all those gas lamps! When Edison finally perfected his *light bulb*, not only did he change the future of the human race, but he also

showed the gas company who was *foolish*. It is certain that the nuclear power industry would rather have people remain ignorant of solar power and its grand potential for as long as possible. They would rather have people perceive it as "futuristic," when the truth is that much can be done now in solar energy, and its use and history are as *old* as the sun itself.

2. Nonrenewable Resources

2.1 History of Their Use

For centuries before the Industrial Revolution, people relied on the chemical energy of plants and animals and the natural forces of wind and water to provide the necessities of life. As more efficient ways were discovered to use these energy sources, changes took place in the way people lived. After the 18th century when power devices were found that could convert steam and, later, fossil fuel into work, energy consumption grew and people underwent rapid social changes. There were switches from wood to coal and from whale oil to petroleum. Then came the internal combustion engine; electricity; steam, gas, and water turbines for generating power; and then the nuclear age.

The trend has been away from *dispersed* natural forces available for large numbers of people to *limited reservoirs* of intensive chemical energy (fossil fuels) controlled by a few corporations. People have become more dependent, in that they've lost more control over their energy resources.

On a global scale, there are two main patterns of energy consumption:

1. About 80% of the world's energy comes from fossil fuels, about 20% from dung and vegetable wastes, and about 1% from water power (mostly hydroelectric), and minor amounts from nuclear, solar, geo-thermal, and wind power.
2. About 75% of the world's energy is consumed by a few rich countries representing less than 30% of the world's population. (The U.S. has about 6% of the world's population, yet it uses 35% of the total energy.)

Energy consumption is *encouraged* because it is said to reflect growth, though unemployment often increases despite or because of increased usage. Much money is spent to increase energy production, but there should be more interest in energy *conservation* and use of renewable resources. Nonrenewable resources like fossil fuels are limited and destined to be exhausted. If people make themselves *totally* dependent on dwindling supplies, the threat of war over what's left becomes a horrible specter.

Today many of us in the United States draw on what would be the equivalent of 70 mechanical slaves to "enjoy the good life." The first waterwheels produced about 1/2 horsepower, with later versions producing 70 horsepower. Cars can have several hundred, aircraft engines thousands, and a rocket engine for spacecraft may produce more than 20 million horsepower. Electric power plants generate millions. Much of the world suffers from hunger and malnutrition (70,000,000 people face starvation yearly), so if we and our fellow human beings are to have any quality of life, we should cut down on our energy consumption and look to new sources of *renewable energy for power*.

2.2 Disadvantages of Nonrenewable Energy Sources

Aside from the fact that nonrenewable energy sources are in limited supply, the main reason for not using them is the pollution, health, and safety risks involved. Some say there are "three environmental time bombs"; toxic chemical pollution, carbon dioxide (CO2) buildup, and acid rain.

The buildup of CO2 in the earth's atmosphere is often referred to as "the greenhouse effect." By burning fossil fuels and cutting down forests, people have caused an increase of carbon dioxide in the atmosphere, which can cause temperatures to rise on a world level. A few degrees difference may not seem important, but on a world scale it can have a dramatic effect. (Some say there would be increased melting of polar ice caps, for one thing.)

As coal, oil, and natural gas are burned worldwide, smokestacks of electricity—generating plants, industrial boilers and smelters release sulfur dioxide (SO2) arid nitrogen oxides. Nitrogen oxides also come out of auto exhaust pipes and slowly escape from chemical fertilizers. These emissions have resulted in "acid rain" which damages vegetation and wildlife and can corrode metals. Fish are being destroyed in sensitive areas, and acidifying soils can result in increased leaching of some trace elements, a slowdown of the organisms that break down the contents on the forest floor, and reduced organic nitrogen. For decades, acid rain has eaten into structures like steel bridges and statues. Not only is acid rain destructive, but winds carry the emissions from factories and exhausts into other countries as well. There are no boundaries for air pollution. Some beautiful areas in Scandinavia are getting acid rain from Europe's industrial belt and in some lakes, fish have been virtually eliminated. Canada gets its share of America's acid rain. In an unprecedented lawsuit in 1981, Maine Attorney General, James Tierney, said he was considering suing the federal government and other states because of drifting air pollution that caused acid rain. He wanted laws concerning sulfur dioxide emissions strengthened, and states with weak laws held liable.

No one yet knows for sure what acid rain might do to *humans*. Dry, airborne pollutants are largely associated with respiratory diseases. One estimate in 1975 suggested that "acid sulphates from fossil fuel emissions are responsible for 7,500 to 12,000 deaths a year." This can't be proved, of course, since so many factors influence peoples' health that one particular cause of death is always difficult to pinpoint, (as in cases of radiation exposure).

2.3 Water Pollution

Forty-three percent of America's community drinking water systems are reporting violations of federal health standards. In addition, 13,600 of the nation's 65,000 systems have inadequate treatment facilities. People often aren't aware of any dangers in their water. In 1980, of 146,000 violations recorded, public notice was made in 16,000 cases. In 1981, New Hampshire officials warned 14 communities that traces of arsenic had been detected in their public water supplies. Virtually every stream, river, and lake in the country is polluted. There is runoff from fertilizers and insecticides, industrial waste, and thermal pollution in overheated waters. (Nuclear power plants produce more thermal pollution than conventional steam electric plants.) In New Orleans, 112 different chemicals were found in a sample of drinking water, and the rate of cancer is going up. At least 40% of the population is using water that has been used at least once before for domestic or industrial purposes, sometimes as many as five times by other people.

Some chemical substances interact with one another in water to form entirely new, often dangerous, chemicals. Chlorine can react with decomposing leaves and become chloroform. Chlorine has been accused of causing cancer, yet most of the "drinking" water in America is now chlorinated, fluoridated, and so on.

2.4 More Environmental Pollution

In 1970, a study showed that 200,000 children in the U.S. had overly toxic levels of lead in their

bloodstream. A more recent article stated that this number is more like 600,000. These figures don't include adults, and most people aren't even tested for lead in their bloodstream anyway. Auto exhausts and industry are putting this lead into the environment.

According to a study by the National Wildlife Federation (the country's largest nongovernmental conservation group), most of the environmental indicators of the "quality of life" show deterioration. Supposedly, 90% of all major U.S. factories now comply with pollution laws, but the report said most Americans live in areas where it is still unsafe to breathe. Land is unwisely used, soil erodes and gets poisoned, water is wasted and polluted (with over 70,000 chemicals in current commercial use, runoff can bring many to waterways), and the endangered species list has more than doubled. All these gloomy changes reflect our choice of energy consumption, and much waste and greed.

2.5 Nonrenewable Energy Used In the Home

With today's increased interest in good insulation, one must be extremely cautious in providing *adequate ventilation* since fumes, gases, and other toxic vapors are the byproduct of nonrenewable energy use. (This is the advantage *solar power* has over fossil fuels—it is *clean* and *safe*.) If you're using "traditional" energy sources, you must be aware that in insulating to retain heat, you may also be retaining such things as radioactive radon and its decay products or formaldehyde escaping from some types of insulation (a popular new insulation is urea formaldehyde— beware). For insulation one *can* use vermiculite, perlite, and expanded silicate—inert minerals that don't release fumes. You may be retaining formaldehyde fumes from particle board, hydrocarbons from gas stoves, and petrochemicals from paints to cleaning fluids. Soft coal fires put benzopyrene (another carcinogen) into the air. At only one part per two million, formaldehyde can cause swelling of mucous membranes. Higher levels can result in coughing, chest pains, headaches, cold- and flu-like symptoms, eye and nose irritations, bloody noses, scratchy throat, nausea, and possibly cancer. Recently, some investigations were made into complaints from people in new, well-insulated mobile homes where formaldehyde gas was detected.

Many people didn't link symptoms, which are so often associated with other "common illnesses, to anything serious so it took awhile for *any* connection to be made to formaldehyde. Often the most common building materials— concrete, brick, stone, and adobe—contain trace amounts of radium and uranium. These levels, are measurable with equipment similar to a geiger counter. As insulation to a home increases and drafts and ventilation decrease, more radon is retained at higher levels. Normally, when fresh air seeps into a house, the air is completely exchanged in one hour, but heavy insulation can reduce this air exchange to once every five hours. Some heavily-insulated homes have been measured with an annual dose exceeding permissible levels for uranium mines. The Environmental Protection Agency examined the radon issue and concluded that 10,000 lung cancers diagnosed yearly could be caused by this radioactive gas, and warned that deaths could double or triple with increased heavy insulation. Ventilation with fresh air is *necessary.*

Gas appliances, stoves, and heaters are another source of indoor air pollution. Natural gas is one of many petrochemical agents capable of creating symptoms like arthritis, depression, water retention, and abdominal distention in *even the best-ventilated homes*. (Here, one must realize that one should not inhale a toxic fume—indoors or outdoors—because toxic is toxic, so ventilation isn't really relevant here. If one does use gas though, one should of course still ventilate as much as possible.) With gas stoves, emissions from combustion are exhausted *directly* into the air. Such an oversight would never be allowed with any other burning material, because we know that the products of combustion are hazardous to inhale. The two major pollutants produced by combustion are carbon monoxide and nitrogen dioxide. Carbon monoxide displaces oxygen in our blood's hemoglobin, and can cause headaches, exhaustion and asphyxiation. Nitrogen dioxide is a byproduct of high-temperature combustion, and studies have shown that levels may be five times greater indoors than outdoors, especially in major cities. One investigation found that operating a gas oven at 350 degrees for one hour, with little ventilation, resulted in excessive levels of carbon monoxide in the house. Excessive amounts

were also found with moderate ventilation, but levels did decrease when speed of ventilating fans was increased. The health hazards of cooking with natural gas are mostly respiratory in nature, and some studies showed a statistically significant difference in lung capacity between children living in homes with gas stoves and those with electric ranges. Another study showed that twice as many residents with gas reported chronic coughing, and three times as many had impaired lung function. (Fortunately, those of us on *raw food diets* need not be burdened with these worries but not everyone is so fortunate.)

Kerosene heaters, sold by the millions the last five years, give off substantial amounts of carbon monoxide, nitrogen dioxide, carbon dioxide, and sulfur dioxide. These emissions are said to be especially dangerous to pregnant women and their fetuses, babies, and persons with respiratory problems, anemia, angina pectoris, or a heart condition. Any unvented heaters are obviously sending combustion byproducts right into the room just like a gas stove. (Some heaters also present fire hazards if improperly used.)

Lignite is a low-grade coal that poses several health problems. Uranium in the material above lignite deposits could cause both pollution *and* health danger when disturbed. Those operating a lignite plant are working close to known carcinogens, and emissions from the plant include sulfur oxides, which combine with moisture in the air and produce sulfurous acid, sulfuric acid, and ammonium sulfate which can corrode buildings, damage vegetation, and cause respiratory ailments. Much carbon dioxide is formed and released, and it combines with water to form acid rain. Lignite has been presented in some areas as an alternative to nuclear power, but people living near lignite plants would absorb about five to six times as many milli-rems of radiation as the "accepted maximum dosage allowed" for areas around nuclear power plants. When lignite burns, radioactive isotopes are released. Nearby water risks contamination and depletion because vast amounts of water are used at all stages from mining to burning and sludge disposal.

We can see why it will be a welcome relief to make the switch to a cleaner, safer energy source that doesn't result in so many complications and compromises! Yet the negative side-effects of all these nonrenewable energy sources pale in comparison with the problems encountered with nuclear power.

3. Nuclear Power

3.1 The Politics of Energy

In 1981, there were 78 nuclear power plants operating or under construction, with 16 more on order. Outside the U.S., there were 182 operating reactor units with another 138 under construction.

One of the first things to remember in dealing with the politics of nuclear power is that using nuclear power to solve the energy crisis seems perfectly normal to the select few who will profit from it and perhaps not be affected by its dangers. This "privileged elite" must convince the workers who labor that a common good will come of it all, although the elite will keep control over the largest portion of the resulting wealth. It has been this way since the beginning of time. Near the top we find people at the next layer of power—the professionals. These are our educated. Intellectuals are usually glad to compromise ethics for the generous compensation given out by those at the top. (We might note that doctors fit into this category, as do many scientists, engineers, corporate executives, and so on.) There is always a "professional" ready to tell you why nuclear power is safe and desirable, just as the surgeon will insist that his surgery is safe and necessary. When "studies" show that "all is well," one might do well to note that many a drug has "passed inspection" and many pesticides have "been approved" all

because of "studies." It is suspiciously easy to find scientists who will come up with just about any result desired by commercial interests.

There were biologists in laboratories funded for 20 years at $50 to $90 million per year to study the biological hazards of ionizing radiation, but *little* has been said on the possibility of death (which is certainly a "biological hazard"). But because cancer can begin for a variety of reasons, it is conveniently impossible to prove that a particular cancer or death was caused by radiation. This protects private and governmental polluters, because who can *prove* they have caused even *one* cancer?

It is certain that ionizing radiation can induce cancer in humans, and it can also be mutagenic—mutation-causing. It's hard to know what damage has already been done to future generations by the continued casual dumping of pollutants into the biosphere by "advanced" nations. Would we be as willing to accept nuclear power if we had to *name* 100 or 1,000 or 100,000 people each year to be executed by a firing squad in exchange for electricity? How different is it to give the go-ahead for nuclear power, when the same odds are at stake, and victims are like guinea pigs in an experiment?

Nuclear power appeals to the privileged elites that control all societies, because it is a centralized system, not a do-it-yourself technology like solar power—it allows them better financial control. Power is being centralized in other areas such as the auto industry, food growing/distributing functions, and so on. The energy source that best meets the need of the elite is that which guarantees *dependence* on a central source. (You'd probably see that *centralized* solar electric systems would be the first strongly promoted types of solar energy if the energy companies become involved.)

Although nuclear power is being pushed with a fervor, it is becoming outrageously expensive and many power plants are plagued with cost overruns, because the costs of the nuclear industry are rapidly escalating.

There is another, more subtle side to the financial coin with regards to the politics of energy known as "economic blackmail." People are taking whatever jobs are available because of their basic survival instinct. So, if a scientist does speak out, he may say something like "a solution for *managing* radioactive poisons will be found" instead of "radioactive poisons are hazardous to your health" (or "run for the hills!"). In fact, some have even gone so far as to say "don't worry if you get cancer—they're working on finding a 'cure' now!" Not very reassuring.

Use of nuclear power violates our most basic law, not to kill, because it implies premeditated random murder, committed by all the nuclear power plants. (In 1978, *Honicker vs. Hendrie*, a lawsuit challenging the "right" of the Nuclear Regulatory Commission to commit premeditated random murder by licensing nuclear power plants, was filed.) We will discuss how nuclear power plants cause deaths and genetic damage in the population later.

Long ago the government teamed up with industry to perpetuate a fraud about the safety of nuclear power— one source likened this fraud to "making Watergate seem like a kindergarten picnic."

Whatever happened to our inalienable constitutional rights to *life*, liberty, and the pursuit of happiness? Nuclear power will commit crimes against innocent victims, now and in the future. We seem to have forgotten that these future people will be more *highly-evolved* human beings. It is quite unlikely that they would choose to be poisoned if they had the chance to decide for *themselves!*

We are becoming involuntary human subjects, being experimented on daily by chemical compounds in the atmosphere. Remember that in the mid-50s, the toxicity of low-dose radiation was "uncertain," so bombs were tested in our own country. Now people with cancer that lived near test sites and were told they were "safe" are suing the government. We are becoming more and more aware of the dangers of radiation. The crime goes from "experiment" to murder, and if this permission for random murder is *granted*, people risk loss of freedom, justice, and their lives.

It is ironic that when antinuclear activists are arrested at demonstrations, some people just see them as "protesters," when here they are trying to wake up a slumbering public, and save the lives of this

generation and of generations not yet born—definitely humanitarian motives.

Up to 1969, the Atomic Energy Commission (AEC) and nuclear industries promoted the idea that radiation would do no harm to humans below a certain level. Since it is now known that there is *no* safe dose, the so-called "safe" standards for public exposure could have caused 32,000 extra cancer deaths per year (and that's assuming the public wasn't exposed to *more* than the "safe" limit). Chances are the exposure was, and is, higher. The genetic consequences after several generations could be between 100,000 and 1,000,000 extra deaths a year. The AEC and nuclear industry tried to ridicule and deny these statistics, but after a two-year study, a committee of the National Academy of Sciences *agreed* that there was no safe dose of radiation, though their estimate of the number of deaths was lower. Nevertheless, their estimates did admit to many thousands of deaths. (The official recognized statistic of the nuclear power industry is 0-3 possible cancers a year.)

When pressured further, the AEC and nuclear industry, instead of *lowering* the allowed radiation dose, then said that they "don't intend to *give* anyone the dose permitted by regulations anyway. "That's not very helpful when we can see from the history of pollution of any sort that polluters always pollute as much, or *more*, than is legal. When an industry doesn't want to *lower* a poison's legal limit, it is because it plans to give *at least* the presently permitted dose. Doses that exceed the "permitted" level because of some unforeseeable accident *will not count* because they fall into the category of "unplanned" or "abnormal" circumstances. So, whatever dose we get will be "O.K." as long as it's unplanned!

Often the nuclear power promoters will remind us that we're exposed to "natural" radiation from the earth. Perhaps so, but we can't very well move from the plant. That source of radiation is bad enough without that imposed by the nuclear power industry. They also say that there won't be more radiation than say, our X rays might give us; here, beware, for X rays are harmful since there's no safe dose of radiation.

We can already see how complex nuclear power is, but this is just scraping the surface. Let's see what else happens before, during and after nuclear power production.

3.2 The Dangers of Nuclear Power Problems BEFORE We Get to the Plant

When uranium is mined, two highly carcinogenic and radioactive substances are released: radium and radon. Radium, an alpha-emitter with a half life of 1,600 years, is a decay product of uranium which is found in uranium ore. Its particles of dust from uranium mines are swallowed, the radium is absorbed by the intestine and can cause cancer. Radon, a gas, can cause lung cancer if inhaled. Before the dangers of radon were known, 20% of all uranium miners in the United States died of lung cancer and a similar percentage was found among German and Canadian uranium miners.

After the ore is mined, it's ground, crushed, and chemically treated to extract the purified element. The waste ore, called tailings, is discarded outside the mill and left lying on the ground in huge mounds. To fuel a *single* power plant for a year can create a half a *billion* pounds of tailings. These tailings contain thorium (halflife of 76,000 years) and radium. If the radium is exposed to the air, it will give off radon gas for as long as 800,000 years. This radon gas is killing people *now* and can do so for at least the next billion years.

Until recently, hundreds of acres of tailings lay on the ground in Grand Junction, Colorado. In the mid-60s, tailings were used around town for cheap landfill and concrete mix, and this went into schools, hospitals, private homes, roads, an airport, and a shopping mall. In 1970, a local doctor noticed an increase of cleft palate, cleft lip, and other congenital defects among newborn babies in the area. Further investigation showed that parents of these children lived in houses built with tailings, and when tested, many of these buildings showed very high radiation levels. Soon after this, some people at the University of Colorado got funds from the former Environmental Protection Agency to study the correlation between low-level radiation and a rise in birth defects—a year later funds were cut off and they were told the government had to cut back on many programs for "budgetary reasons."

Next, uranium ore must be "enriched" so that its Uranium-235 content makes up 3% of its bulk, since only 0.7% of the uranium found in its natural state is of the U-235 variety. This process is extremely expensive and uses vast amounts of energy. It leaves radioactive tailings similar to those produced in milling the ore. In the United States, the federal government has to subsidize the enrichment process because it costs so much.

After enrichment, uranium ore is processed into small pellets. A typical 1,000-megawatt reactor has bundles of fuel rods that use 100 tons of uranium. (Workers exposed in making these pellets are susceptible to dangers of gamma radiation emitted from the enriched fuel.) The enriched uranium is now ready to undergo fission, during which hundreds of radioactive isotopes (all carcinogenic and mutagenic) with half-lives ranging from several seconds to 24,400 years are released. Even though symptoms haven't appeared, the doses already received by workers will result in thousands of cancer victims, and this random murder of workers is politely referred to as "health effects" by government regulatory agencies. Fifteen years of records from one of the two hospitals in Durango, Colorado, site of one of the nation's huge exposed radioactive mill tailings piles (a 1.5 million ton pile), show a rate of lung cancer four times the national average. Earlier in 1979, more than 30 radioactive sites were discovered in Denver and elsewhere in Colorado-remnants of the radium industry that flourished at the turn of the century. There are over 4,000 such radioactive sites in this country.

Workers at mines are exposed to higher levels of radioactivity, radon, and toxic materials than the public, and there are even infractions of the official "safe" dosages. Many workers are poorly informed on the dangers of the materials they are working with. Worker turnover is high and no follow-up is done on workers. Some long-range effects of exposure may not show up until years later.

After the uranium is mined, it must be transported to its final destinations. Our nation's highways and railroads are being crossed daily with radioactive materials and workers who handle these shipments are often exposed to radiation. Between 1974 and 1978, there were 328 transport accidents involving radioactive cargo—118 serious enough to release radiation into the environment. (This amounts to about three accidents every two weeks involving shipment of radioactive materials.) Nine out of ten occurred on public highways. (Even planes carrying nuclear weapons have crashed—there are over 30 such accidents on official record, but one source says this may be a fourth of the real number.) Civil defense and fire personnel are ill-equipped to handle nuclear emergencies.

Another problem with nuclear power is the choice of some of the power plant locations. There are quite a few nuclear reactors in geologically unsound areas. The South Texas nuclear plant is being built over the convergence of three earthquake fault lines and is built to withstand 90-mph winds in an area where hurricane winds have been known to greatly exceed that. The Diablo Canyon (California) power plant is three miles from an offshore earthquake fault, and other California plants have been built that are dangerously close to fault systems. Within a 200-mile radius of New Madrid, Missouri (the region hit by powerful quakes in 1811), nine nuclear power plants are situated. In New York state, the Indian Point power station is located within a mile of the Ramapo fault system, and this plant is only about 25 miles north of New York! The industry will say that power plants are designed to withstand earthquakes but in 1979 the Nuclear Regulatory Commission closed five eastern power plants because an error in the computer model used by the engineering company understated the stresses that the piping in the coolant systems of the reactors might have to withstand in the event of an earthquake. (We will discuss meltdowns, which can result with failure of the cooling systems, later.) About a month later, an earthquake struck Bath, Maine, with tremors being felt in a 200-mile radius, which includes three nuclear power plants.

Another problem with nuclear power is that the fuels used can be used to make bombs and are therefore vulnerable to theft, smuggling, and terrorist activity. Approximately two *tons* of weapons-grade enriched uranium and plutonium have already been stolen from nuclear facilities in the United States. These thefts, whether by nations, terrorist groups, or criminal elements will become a standard feature of a nuclear world.

3.3 Problems At the Power Plant

Once inside the plant, we can become concerned with the possibility of sabotage of the power plant, i.e., terrorist threats, or blackmail. Then come engineering defects and errors, which have been discovered; the problem of "human error" in the nuclear industry is a big one because the stakes are so high. Next, we have "routine emissions" and leaks such as: a mechanical failure that caused a plant to "burp" radioactive xenon gas into the atmosphere, or radioactive steam that spewed into the air for 27 minutes at another power plant. Hundreds of these "nonserious" accidents are on record over the years, and the space of this lesson does not permit coverage of all the mistakes. Suffice it to say there is a wealth of documented scare stories available.

Perhaps the best known failure was at Three Mile Island, when a series of accidents led to a buildup of pressure in the reactor and the release of radioactive steam into the atmosphere. The atomic core was difficult to cool, radiation leaked, and a hydrogen gas bubble inside the reactor could have become explosive.

Estimates were made that childhood cancers could increase up to 60% in the five years following this accident within a 200-rriile radius of the plant. If the worst had happened at Three Mile Island, at least 200 and perhaps up to 23,000 outside a 50-mile radius would have died of cancer.

The biggest danger in nuclear power is the possibility of a meltdown. Whether caused by a defect in design or construction, human error, or sabotage, it could release a reactor's deadly radioactive contents into the atmosphere, killing thousands of people and contaminating an area the size of Pennsylvania. Over the course of the next generation, genetic abnormalities and thyroid cancer would strike untold numbers of additional people.

A meltdown can occur if the coolant water at a reactor's core drops below the level of the fuel rods, which would become so hot that they would melt and then the whole mass of molten uranium would burn through the "container" (the concrete base of the plant) and 1/4 mile into the earth, triggering a tremendous explosion that would blow the containment vessel apart, releasing the radioactive elements into the atmosphere. After the blast thousands die immediately. More would did within two to three weeks of acute radiation illness. Food, water, and air would be so grossly contaminated that in five years there would be widespread leukemia, followed 15-40 years later by an upsurge in cancers. The genetic deformities that might appear in future generations are inconceivable.

The potential enormity of such a meltdown cannot be exaggerated. The Union of Concerned Scientists conducted a two-year study that projected 15,000 people could die of radiation-induced cancer from minor reactor accidents by the year 2000. In the same period, there's a 1% chance that a major nuclear accident will occur, killing nearly 100,000 people. There have already been some close calls.

We still haven't mentioned the "routine" exposure to radiation of nuclear power plant workers themselves. As with uranium miners, they are often not informed specifically of the dangers of radiation, only told in *general* terms that it can be dangerous. Workers wear badges that monitor the level of exposure to radiation, but this device registers only gamma radiation and disregards alpha and beta emissions, which can be swallowed or inhaled. Workers are permitted to receive 30 times as much radiation as the limit set for the general public. The nuclear industry keeps records of no more than five years after an employee leaves the job. This is obviously ineffective in pinpointing slower developing cancers or in spotting cancer in the *offspring* of victims. Unskilled or migrant laborers are often hired for high wages in areas of intense radiation. After they receive their six-month allowable dose at one facility (sometimes in only *one day*) they may be hired on at another power plant without ever being questioned about their previous radiation exposure. (When a pipe broke at the Indian Point plant and it was rendered inoperable for six months, 1,300 certified welders—almost every certified welder in the New York area —were needed to repair the damage. This is because within a few minutes, each worker would receive the dose of radiation "allowable" in a six-month period.)

Last year, statistics on 68 operating plants showed that their work forces were exposed to 35% more

radiation in 1980 than in 1979 even though there was only one new plant. The doses these workers get can provoke genetic injury; with intermarriage with nonworkers, some genetic degradation of the population-at-large can result.

Studies have also shown increased cancer in areas around nuclear power plants. A nuclear power plant must release radiation into the environment in order to do its job. Low-level radiation, the alpha particles get carried away on dust or pollen by wind or water.

Every *independent* study in this country in the last 20 years (i.e., studies not conducted by the nuclear power industry) has shown that current standards of radiation are too high. Workers and the public have been deceived concerning "permissible" or "tolerable" doses of radiation. There will be injuries in proportion to the *accumulated* dose of radiation, down to the lowest doses, although radiation effects may not show up for as long as 30 years. (Remember, however, if genetic damage occurs, it is *immediate*.) Still, the nuclear power industry continues to claim that "no one's been harmed by radiation."

Radiation is insidious because it cannot be detected by the senses. We are not biologically equipped to feel its powers, or see, hear, touch, or smell it. Radiation harms us by ionizing—that is, altering the electrical charge of the atoms and molecules comprising our body cells. Of all creatures on earth, human beings are one of the most susceptible to the carcinogenic effects of radiation. There is also one flower that is very sensitive to small amounts of radiation, called the *Tradescantia* or spiderwort. Down to 250 to 300 millirems of radiation can change the genetic character of this plant so that it changes color—the stamen changes color—so they have planted them around nuclear power plants in Japan.

Within every cell there is thought to be a regulatory gene that controls the cell's rate of division. If our bodies are irradiated or we inhale a particle of radioactive matter into our lungs, this radiation can chemically damage a regulatory cell. It may continue to function normally, but one day, five to forty years later, instead of dividing to produce two new cells, it goes berserk and manufactures billions of identically-damaged cells. This type of growth is called cancer. Cancer cells can break from the main mass of the growth, or tumor, and enter the blood or lymph vessels, travel to other organs, and divide again uncontrollably to form new tumors. These cells are more aggressive than normal body cells. This is why there is no safe dosage of radiation—it takes only one radioactive atom, one cell, and one gene to initiate a cancer or mutation cycle.

In considering all these facts on radiation, we should remember one important fact, that all the nuclear industries are relatively *young*. Nuclear power has only been in commercial production in the United States for 25 years, and arms production for 35. Since the latency period of cancer is five to forty years and genetic mutations may not manifest themselves for *generations*, we can see that we have barely begun to experience the effects radiation can have upon us. (Madame Curie, who is known for her work with uranium, died later, not having known in time the dangers of the substance she worked with.)

The moment a plant begins operation, injury to humans, is guaranteed. Nuclides are released during so-called "normal" operations. Because the "regulatory" processes do not want to protect the public and licenses continue to be granted, it is clear that we cannot count on protection against victimization through the regulatory process. Even the Environmental Protection Agency said in 1975 that nuclear power will kill hundreds of people yearly even if everything goes perfectly. (This, again, is an underestimation of victims.) The Nuclear Regulatory Commission did admit in 1978 what others had already said, that there was no safe dose of ionizing radiation, and no "threshold."

In the meantime, we are injured in the form of mental anguish. People have already undergone a certain amount of "psychic numbing" by the shadow of potential nuclear war hanging over their heads, in which continual stress has caused them to try to "blank out" the fears. Most humans don't want electricity at the cost of death or injury to themselves or their fellow people.

Because uranium resources could be depleted at the turn of the century, the nuclear industry wants *breeder reactors* to ensure a future for nuclear power. These reactors are expensive, dangerous, and

would require production and shipping of plutonium—a poisonous, carcinogenic material used in hydrogen bombs. The breeders would use up the wastes of the first generation of nuclear reactors and "breed" their own future fuel supplies by creating even more plutonium over time. Whether fueled by plutonium or thorium U-233, these substances will be produced and handled by the *thousands of tons*. These two substances are in the class of alpha-emitters, providing the same radiation as has claimed the lives of uranium miners by lung cancer. Plutonium is so toxic that current occupational limits allow a worker to inhale no more than 0.2 of a *millionth* of a gram over his lifetime (one must, of course, be suspicious of *any* "safe" dose).

Plutonium and uranium are the stuff from which atomic bombs are fabricated, and as we mentioned before, several tons can't be accounted for by the processors already.

Errors plague the production of breeders just as with the regular light water reactors—in the extreme, a breeder reactor can suffer a runaway nuclear reaction and conceivably blow itself apart. ("It could make Three Mile Island look like a tea party," said Thomas Cochran of the Natural Resources Defense Council.)

One-half pound of plutonium trapped in human lungs could cause billions of lung cancers. Yet there are waste sites of plutonium with leaking rusty barrels, and there have been plutonium spills, and it has been tracked around by workers, accidentally found on the ground and elsewhere in plants handling plutonium, and so forth. At one point, planes were carrying plutonium oxide into Kennedy airport until these flights were stopped, after some calculations figured that a crash causing plutonium dispersal could have killed the 8,000,000 residents of New York City at the time! Plutonium in the earth, under its mantle, doesn't pose a threat—it's the airborne plutonium that creates the inhalation hazard.

Let's stop a moment and see what *responsibility* the nuclear industry has taken to ensure our safety. The Price-Anderson Act was passed in the 1950s to *absolve* America's power companies of major responsibility in the event of a nuclear disaster. Without such a bill, the nuclear industry would have never gotten off the ground. (If insurance companies were willing to cover the risk, the premium required to ensure a nuclear power plant yearly could be roughly equivalent to the entire yearly costs of plant operation and maintenance.)

In cases of extreme nuclear accidents, we might also do well to question how quickly and effectively evacuations would take place. How would a city like New York be evacuated within hours?

If we have managed to make it through the production and power plant operation phases, we come to the final problem posed by the use of nuclear power: nuclear *waste*.

3.4 Problems After the Plant—Nuclear Waste

It may be noted that much ado is made about waste disposal, sometimes to divert peoples' attention from the fact that even without the waste, the reactors are killing people now. It's easier to promise people safety and "99.9% containment," and then catch them up in the emotions of the waste dumping issue than to admit this fact. This is not to say, of course, that waste disposal isn't also crucial. The entire cycle of nuclear power is serious.

What exactly is the cause for concern with nuclear waste? The General Accounting Office of Congress has said that by the end of the century there could be one-*billion* cubic feet of nuclear waste in the United States—enough to cover a four-lane highway coast to coast a foot deep.

The operation of nuclear reactors generates astronomical quantities of radioactive garbage of several types, the amount of radioactivity generated being in direct proportion to the amount of electricity produced. In one year a 1,000-megawatt nuclear power plant generates fission products (like Strontium-90 and Cesium-137) in a quantity equal to what is produced by the explosion of 23 megatons of nuclear fission bombs—or more than 1,000 bombs of the Hiroshima size! (Remember, the industry wants 300 or 400 such plants in the U.S.A. alone by the year 2000.) This means that every year we would generate the

Strontium-90 and Cesium-137 garbage equivalent to a *full-scale nuclear war*, year after year until fuel runs out. If breeders are developed, we could have 1,000 to 2,000 plants, because they solve their own fuel shortage problem.

This is one of the few facts *not* disputed by the experts, how much waste would be produced—because waste is waste and its amount is determined by the law of physics. However, it cannot be destroyed—it must be *stored*. It carries the risk of cancer and genetic damage and must therefore be isolated. If released into the environment, it will contaminate land and water. Do we have a moral right to unload these poisons on future generations when it is obvious we *ourselves* do not know what to do with them?

Even after 1,000 years the waste will still remain dangerous isotopes. Plutonium takes about a quarter-of-a-million years, or more, to decay to relatively "safe" levels (and of course this "safe" is doubtful when agreement can't even be reached on what *is* "safe").

Remember that the Bering Strait was dry land 12,000 years ago. So if we're talking about plutonium and 250,000 years, we're dealing with a time period during which volcanos, earthquakes, changes in the continental plates a themselves, meteors, or who knows what else can shape or reshape our physical world. We're talking about *hundreds* of generations of humans into the future. We cannot even conceive of all the possible changes in their environment or evolution, and this is our legacy to them?

No one can honestly say that all that waste can be safely contained for such lengths of time. Who will be keeping watch all those years? Even languages change over time. What manmade storage containers can last all that time? There have already been numerous leaks at waste storage facilities and toxic waste dumps.

No matter how much waste is produced, it is the incredible *toxicity* of the waste that concerns us. Strontium-90 takes 300-600 years to decay to a relatively "safe" level. If ingested, it can lodge permanently in the bones, replacing calcium. Cesium-137 lasts about the same time, and seeks out the reproductive system. (Remember, the half-life is not the *length* of time which a radioactive material is dangerous—it may be dangerous for five to twenty half-lives.) Iodine-129 has a half-life of 17 million years. This concentrates easily in the food chain and in the thyroid gland. Some fission products are gases, generally even harder to contain than other forms of radioactive materials. Remember that the reactor vessel construction materials are also irradiated for the operating life of the reactor. As a result, a reactor can't be approached without special shielding for 1 1/2 million years, *much longer than the lifetime of any manmade structure!*

Who wants to store nuclear waste in their back yard? There are constant battles by citizens for their rights. There have already been numerous scandals, such as a company in Florida illegally dumping hazardous radioactive waste into an open dumpster, and, in another state, putting it illegally into a public dump. Soil and ditches have been found to be contaminated, and the U.S. has been dumping wastes off-shore around the country.

Leaking barrels in the Pacific Ocean have been photographed with giant mutant sponges clinging to their exteriors. A Texas waste facility located outside of Galveston was found to have barrels leaking deadly plutonium, and they had thousands of barrels over the legal 2,000-barrel limit.

We still can't even be sure the waste is being 100% contained on the *way* to these storage sites, and must hope that no transportation accidents occur. Assuming it arrives at the dump, we can ask ourselves how radioactive garbage buried in plastic sacks or rustable barrels in shallow trenches is *contained* or *permanently isolated* from the environment and people. Much waste is now buried that way, although as time goes on, awareness has increased on the importance of good containers (although we don't know if anything for sure resists *all* the ravages of time). In 1978, the Department of Energy asked the public for help in *finding* its buried radioactive wastes—since many records were misplaced or destroyed over the years, the DOE asked that anyone who knew where such work was once done contact them! (The sites were used for nuclear work from the 1940s through the 1960s.)

Some proposals for disposal of nuclear waste have included lowering it into deep geologic repositories

or salt domes, into ice, under the sea, and so on—all of these are subject to possible geologic disturbances. Some scientists have suggested sending it to space (with the hopes that a departing rocket filled with waste does not return to earth by mistake). There have even been some people, devoid of any conscience whatsoever, who have advocated shipping our toxic wastes "abroad," where laws aren't yet as strict, and people might not be as aware of the dangers. (Definitely shaky foreign policy!) The nuclear power industry is plagued with moral problems from beginning to end. (It is interesting to note, by the way, that the American Medical Association, of all people, stoutly *defends* nuclear power. Perhaps they're anxiously awaiting all those radiated customers, who will be begging them for "cures.")

In the face of all this insanity, what does the nuclear power industry do when confronted with delicate issues? Like a good magician, it first attempts to divert attention from what's really happening. If its propaganda and tricks fail to work, however, it simply lies. The history of fraud and deceit in the nuclear power industry is long and full of "silenced concerns" and rigged or suppressed studies.

Usually whenever leaks are *independently* measured, for example, higher contamination is found than in the "official" measurements. It seems the fox is "guarding the chicken coop."

There have been cases where conscientious workers trying to bring violations to attention or inspectors at power plants have been harassed. (Inspectors in Texas reported to the Nuclear Regulatory Commission that they had been threatened by construction workers.)

So, we must involve ourselves now in ridding the world of nuclear power *and* nuclear weapons. It is a matter of survival of the planet. A thirty-minute nuclear exchange could erase all life on earth forever. Helen Caldicott has said *"we are talking about the most important issue facing the human race."*

According to the Stockholm International Peace Research Institute, the world spent *$1 million a minute* in 1980 on armaments and other military spending. If this money were spent on solving our energy problems, the world would be saved.

A Hygienic way of life and peace go hand-in-hand. Now let's return to *positive* energy, back to solar power, a ray of hope for mankind.

4. Solar Systems

4.1 Active and Passive Systems

An active solar system uses collectors to absorb the sun's heat and needs mechanical components to transfer the heat to a storage system and to circulate it to supply buildings with hot water and space heating. The mechanical parts can be pumps, fans, or other controls.

A passive solar system for heating or cooling doesn't require mechanical devices because the structure itself serves as a collector and storage medium. It relies on design features such as proper building and room orientation towards the sun, large south-facing windows, and insulating shutters and overhangs for summer shading to maximize solar gain in winter and minimize it in summer. Passive solar is best suited for new construction and space heating and cooling.

A solar greenhouse is one of the best passive heating systems for a house. Having numerous south-facing windows helps to heat a house too. Using passive solar heating combined with a solar electric system, and backed up by an active system, is a healthful alternative to using nonrenewable energy sources that create pollution.

4.2 Solar Water Heat

A passive solar water heater in one of its simplest forms consists of a tank painted black, mounted on a reflective surface and sealed into an airtight box that has a glazed front that lets the sun's rays in to be absorbed into the black tank (black is the most heat-absorbent of all colors).

A recycled hot water tank can be painted black and used as a collector, resulting in an extremely lowcost solar water heater. The tank is tripped of its outer covering and surrounded by flexible plastic sheeting. The tank is then mounted on 3/4" plywood covered with shiny metal sheets that reflect as much sun onto the tank as possible.

A typical flat-plate solar collector for heating water is made up of the following parts: the *glazing* is usually something like double strength window glass. The *water tubes* used to be made of copper; now usually aluminium or steel are used for economic reasons. The *flat plate* may be any metal (copper, aluminium, steel) that has good thermal conductivity and is reasonable in cost. The metal plate must be coated with a solar radiation-absorbing paint or plating. Flat black paint, properly applied to prevent peeling and cracking, will do a good job for ordinary domestic solar water heaters. The *insulation* may be any low-conductivity material available (usually something like glass wool) that can withstand temperatures up to 200°F. The *casing* holds the solar collector together and, together with the glazing, makes it water- and dust-proof. A simple wooden box, adequately painted and fitted with a hard-board base, will do. When water flows through the collector, it is heated, starting the solar cycle to work in your house.

One of the most widely-used passive designs for water heating is the thermosyphon hot water heater, which combines a flat-plate solar collector end an insulated water storage tank mounted high enough above the collector so that the cold water will go downward (heat rises, cold settles), where it will be heated by the collector and rise into the storage tank. This slow but continuous circulation continues as long as sun shines on the collector. In a good sunny location with no shadows, a 4' x 8' collector will give 40 to 50 gallons of hot water a day.

4.3 Solar Heating Systems

A simple and inexpensive air heater can be made with a cover glass (plastic film may also be used), a corrugated plate of sheet steel or aluminium painted black, a space through which the air can flow, a layer of insulation and a Masonite or plywood backing to keep the assembly waterproof. The air can be made to flow by a fan or blower, or, if the system is properly designed, it will rise due to convection (the "chimney effect") because the heated air is lighter than the cold air outside.

Air heaters are less expensive than water heaters used to heat air (not the same as the solar hot water heaters just discussed), because there is no need to worry about freezing, and any leakage which occurs will not cause the kind of damage water can create. The pumps used may be larger, more expensive and more power-consuming than those used with some solar water heating systems, though. Also, the ducts used to carry the air are larger and more costly than the pipes used with water systems. Each type has its advantages and disadvantages.

The simplest of all solar air heaters uses a heavy south-facing concrete wall painted a dark color and covered with a sheet of glass. An air space runs between the concrete and glass, and the chimney effect causes the heated air to rise. Openings at the top and bottom of the wall let cold air enter the air space and warm air to reenter the room. The air then circulates around the room. Small electric baseboard heaters can be used for heat during long periods of bad weather.

Solar space heating may be accomplished in many ways, but one must first estimate how much heat the structure will need during adverse winter conditions and at night. The solar heater must be able to provide not only heat during the sunny days but also have additional capacity for heat *storage*.

The best, method presently available for storing heat ,or cold in large amounts is large *water tanks* filled,

or almost filled, with water. We can store about three times as much warmth as cold, since we cannot use such a large temperature range with cold without running into the complication of freezing the water. The mechanics of storing heat in water are simple and water is available almost everywhere.

Heat can also be stored by means of *rock beds*. These can't freeze or leak, but their capacity is limited. However, they can be safely used under a building since not much can happen to them once they're put in place.

In considering all these options for solar systems, we must remember that the space of a lesson does not permit in-depth construction details—there are hundreds of books on solar technology of all sorts, and one must refer to other sources in order to learn the specifics. There have been many, many experiments made with various building materials, designs, and theories, and there are always several methods available for arriving at the same effect, whether this be heating, cooling, or whatever. An individual must determine what best meets his needs as to what's best for his climate, living structure and finances.

4.4 Solar Cooling Systems

There is no way to use the heat of the sun *directly* to produce cooling, however, we can use the heat to produce hot water or steam, and with that we can refrigerate, using the process known as *absorption refrigeration*. This was first discovered in 1824, then, about 100 years later, this principle was used for household refrigerators.

Cooling can be achieved with the aid of a humidifier and by controlling the heat radiation of the thermal mass. The thermal mass itself can be used for cooling during the summer by opening the windows and exposing it to the cool evening void. The stored heat is then radiated back to the depths of space. One way to cool a building which is tight and well-insulated is to close it up during the day. This is done with massive adobe houses. Insulated shutters, thermal curtains, or window quilts can help to keep the heat out and the coolness in.

An example of solar cooling is the "Sytherm Systems" developed by Harold Hay. These systems have large water containers on the roof that are cooled at night and keep the building cool during the day. During the winter days, they collect warmth and radiate it into the dwellings at night.

Shade roofs are roofs with extremely large overhangs and will cool a building; they are especially good in the tropics. Placement of windows to allow breezes through a structure is also helpful in cooling a building. Perhaps the very best way to keep a building cool is to build it underground in the layer of the earth that is always naturally cool in the summer.

4.5 Solar Electricity

About a century ago, a Frenchman, Becquerel, found that sunlight could produce minute amounts of electricity when it entered a very special kind of "wet cell" battery. Later, other workers found that sunlight could change the resistance of certain metals and that very small amounts of electricity would be generated when sunlight illuminated discs of selenium or certain types of copper oxide. These devices were useful as light meters but didn't produce enough power to do anything more than move a pointer on a meter or activate a very sensitive relay. In 1954, a new treatment for ultra-pure silicon was discovered which gave it the property of generating electricity from sunlight with a conversion efficiency of 6%. This was 10 times better than any previous efficiency for the direct conversion of sunlight into electricity, and the invention was immediately applied to a small transistorized radio transmitter and receiver.

In 1957, the space program found a unique application for the silicon solar battery. NASA put silicon cells on its first permanent satellite, and they worked so well that all but one of the satellites orbited since that time have been powered by increasingly complex arrays of silicon solar cells. Communication satellites use tens of thousands of these cells. Each cell alone contributes a small amount of power, but

silicon cell technology has advanced so rapidly that tens of thousands of individual cells can be connected together, rapidly and reliably. Today the communications satellite has become the standard means of intercontinental communication for voice, television, and even computer language.

The cost is still a bit high for installation of great panels of solar cells on every rooftop, but great strides are being made, and the cost has already been reduced from $1,000 per watt to $20 per watt with more reductions on the way. Ways of producing less expensive silicon cells are being intensely studied. Some specialists say the cost will come down to $2 per watt within another decade.

Solar cells come in a wide variety of sizes. There are larger units for supplying large amounts of power, and small photovoltaic devices to supply operating power for devices such as electronic watches, calculators, and flashlights. These small solar devices are called microgenerators, and are actually made up of several extremely small solar cells connected in series.

A solar electric system has no moving parts and usually requires little, if any, maintenance. The two main considerations in the design of any solar electric power system are, first how much sunlight is available at the proposed site and how it varies with the seasons of the year (this tells us the size of the solar electric generator needed to supply any given amount of power), and the second consideration is the characteristics of the load including the average current requirement and the duty cycle (this tells us how much storage battery capacity we will need to keep the system operating when sunlight isn't available).

Solar cells can be used in radio and television, in agriculture (for irrigation, pumping water, charging storage batteries at remote locations, etc.), at construction sites where electricity isn't yet available, in remote areas, for work or recreation, and so on.

Solar arrays should face due south, but "trackers" have been developed, whereby the solar panels are mounted so that they can move, so as to remain pointed in the correct direction at all times for maximum sunlight. A small sensor on the array provides electrical signals that tell the control system which way to turn the array to get the most sun.

4.6 Solar Water Distillers

A solar water distiller consists of a water-tight compartment painted black to absorb the solar radiation which enters through the glass roof of the still. Water which is brackish or impure flows through the box in a four- to six-inch deep channel, where the intense solar heat in the box forces the water to evaporate and to condense on the inner side of the roof where it is drained off to a holding tank. The end result is pure drinking water.

The ocean rescue still, developed in 1940 by Dr. Maria Telkes, can be used to make drinking water from ocean water.

Dr. M. Kobayashi of Tokyo developed a solar still that could extract water from virtually any kind of soil, and tested it at the top of Mt. Fuji where the soil is volcanic ash and in the arid deserts of Pakistan, and he has never failed to produce water that is pure and potable.

4.7 Solar Food Dryers

Solar energy has always been used to dry crops of fruits and vegetables. Essentially this was done by exposing the food to the sun's rays and hoping it wouldn't rain. A more "sophisticated" technology has evolved to use the sun's thermal power and minimize contamination from dust and airborne debris, insects and their larvae, and animal or human interference. The drying area must be covered with a transparent material. A drying "hot box" is constructed and insulated (glass wool is preferred since it can survive any temperature and does not support insect, life). Ventilation holes at the top and bottom allow air to enter and carry away the moisture. An access door makes loading and unloading easier. The interior of the cabinet should be painted black and the exteriors of the side and rear panels painted with

aluminium paint. Drying trays can be made with galvanized wire mesh. Where electricity is available, a small fan may be used to draw air through the dryer, but it is not necessary.

The dryer should be glazed, preferably with two layers of glass, fitted in with adequate room for thermal expansion. Ventilation is essential so that moisture can escape and can be provided by screened air holes in the bottom, sides, and back of the cabinet. Such a dryer can keep produce dry during rain storms, so the glazed top should be watertight. The ventilation is also needed to prevent overheating, since a hot box of this type can readily attain temperatures above 200° F.

4.8 Solar Cookers

The first solar cooker was probably the one built in Bombay in 1880, and several other ingenious ovens have originated in India, as well as in other areas of the world. We won't go into detail since the Hygienic way of life doesn't advocate cooking food, but the student must at least be aware that the technology is available—even if we don't cook, we all know people who do. Solar cooking is cleaner than gas cooking, which sends its toxic combustion products into the room.

5. A Solar Home

5.1 Solarizing Your Present Home

The first step in solarizing your present home is to do an energy "audit"—to determine where the major heat losses occur and where the greatest energy efficiency gains can be made.

Every situation will vary, but one generally good strategy is to add a sunroom or a greenhouse onto the south side of the house. If this isn't possible, at least more *windows* can be added on the south side. If you do have a porch on the south side, or one that at least has a south wall, consider converting it into a greenhouse or sunroom. A south-facing window can be converted into a solar window box greenhouse. We must always make the *most* out of what sun we get.

There are a number of other basic steps that can be taken to conserve energy, thus working with passive solar principles to improve what you already have. Some of these are:

1. Lower thermostat or turn down heater.
2. Turn water heater thermostat down to 120 degrees, and insulate it.
3. Weatherstrip doors and windows.
4. Caulk and seal openings.
5. Add storm windows.
6. Add awnings.
7. Add attic insulation; insulate walls.
8. Convert from gas or electric to wood heat; replace inefficient heaters with more efficient ones.
9. Add fans, vents, and ceiling fans.
10. Insulate pipes and ducts.
11. Add a solar water heater.
12. Add thermal heat storage or thermal mass (one example is a hot tub).
13. Add wood solar hot water heater.
14. Add entry room to act as an air buffer so that massive energy isn't exchanged each time a door is opened (small adjoining room).

15. Add backup active solar systems for air and hot water heating.
16. Add insulated shutters and drapes.

Emphasis should be made again about the importance of providing *adequate ventilation*. We have already discussed the harmful fumes and byproducts of combustion that are present in rooms heated by most conventional methods and fumes that result from unhealthful building materials. Insulation must not become a threat to health. Ideally we could all use clean solar heat, but even then, we would want to remember that fresh air is essential to quality of life. In any case, it's better to add a blanket and sleep with windows cracked—I remember visiting in Switzerland in the mountains a few years ago, and at night we just climbed under the thick down covers—the bedrooms upstairs weren't even heated at all.

We should be conscious of the air quality in our living spaces at all times, waking and sleeping.

5.2 Building a Solar Home

The art of solar building design perhaps began when the cave men carved their dwellings into the south face of a hill in order to benefit most from the warm rays of the sun.

The use of south-facing windows to increase heat gain into a building became popular in the 30s and 40s in this country. In the summer, when the sun is higher in the sky than in winter, carefully designed overhangs shade the south windows and keep the building from overheating. Double-glazed windows or those insulated at night reduce the heat loss more.

The use of a greenhouse as a heat trap is an extension of the solar window design. On dark, cloudy days and at night, the greenhouse can be sealed off from the rest of the house to prevent heat loss. The greenhouse serves as a thermal mass to reradiate stored solar heat at night.

Water provides an excellent thermal mass, and has the highest heat capacity per pound of ordinary material. The storage tank is usually insulated to reduce conductive heat losses.

The seasonal angle of the sun changes in a regular, predictable cycle. When designing overhangs and collector angles, you need to know your latitude and the maximum high and low angles of the sun. The sun changes about 46 degrees from the summer to the winter solstice, higher in summer and lower in the sky in winter.

The *insolation* (or *in*cident *sol*ar radi*ation*) is the amount of energy that reaches the surface at a given location. Insolation tables are available for various latitudes.

Another factor to be considered in choosing a solar site is the amount of shading available. This can be in the form of overhangs or natural vegetation. A combination of shading, cooling, and ventilation elements must be considered as well as the solar factors. Evergreen trees planted to the north of a building help block the cold winter north winds, rain, and snow. Deciduous trees (those that lose their leaves in winter), such as fruit trees, are suitable for planting on the south, east, and west sides. In the fall and winter when the trees are bare, the sun's rays penetrate to the building and in the spring and summer, the hot sun is blocked because the trees are full of leaves, flowers, and fruit. A simple idea thus becomes delicious and rewarding. Vines and climbers can also be planted to shade east, west, and south facades, as well as lattices or trellises covered with growth.

Walls should be as well insulated as possible on the outside and include thermal mass on the inside for heat retention. Thermal mass can consist of 55-gallon drums (water-filled) painted black for maximum absorption, or large rocks. Rocks can be used in the foundation and walls. (If using painted barrels, the nonsolar-collecting sides can be painted any colors.)

Inside walls that receive sunlight can be faced with brick or stone. There should be an insulator like gravel under the floor. Clay tile floors store heat well. They come in a rainbow of colors and designs, making some beautiful mosaics possible, that are both functional *and* aesthetic.

We receive our life nourishment from the sun, so it is only natural that we harness its energy and put it to

good use.

5.3 The Solar Greenhouse

The primary reason for building a greenhouse is, of course, food production. Growing your own food saves money, and it is always ready to be picked—fresh, ripe, and organic, grown without the need for any farm machinery.

As mentioned, the greenhouse may be built on the south side of the building where it will receive full sun. It can be constructed quite simply with concrete blocks for the foundation, and other massive building materials such as ceramic brick, stone, adobe, poured concrete, or cinder blocks can be used for thermal mass. These massive walls are insulated on the outside surface.

For the glazing or clear film that is attached to the frame there arc many choices of material: glass, roll plastic, sheet plastic, corrugated clear plastic, etc. Doors and vents must be tight-fitting and weatherstripped, and all surfaces should fit tightly together.

At night, the windows should be blocked with movable insulating forms or covered with shutters or curtains. This will keep the heat level constant at night.

Heated air in the greenhouse rises and flows into a high opening to the home, and a low opening in the shared wall lets cool air from the house enter the greenhouse for heating. The plants in the greenhouse convert carbon dioxide into oxygen-rich air for the house occupants.

When you build a greenhouse, you will be creating a special space, a microcosm, a living place that will grow and truly add life to your home.

6. Solar Energy And You

Now that you know why it is so important to make the change to renewable energy sources, hopefully you'll try to incorporate some of these changes into your lives. Anything you can do to get other persons in your community involved in promoting the use of solar power and other renewable energy sources will be a step toward saving our planet.

There are solar industries springing up all over the place that you and other interested persons can contact for advice and support.

7. The Future And Politics Of Solar Energy

If there is one organized body capable of the political leverage needed to give solar energy a boost, it is the American union movement. They will be able to see the job potential of solar energy. However, the job-creating powers of solar energy could hold it back in *corporate* circles because industrialists want to keep a certain measure of control over people when there is adequate *unemployment* to hold down wages. That is, the more people out of work, the more competition there is for what jobs are available,

and the easier to keep wages down and hold back unions (of course, no one will admit to this outright). Remember, the nuclear power industry has $100 billion dollars on the line.

In this country the top 19% of families owns about 76% of all the privately-held wealth, with the bottom 25% having no assets at all (Dr. L. C. Thurow, M.I.T. Department of Economics, 1979). The concentration of power and wealth is such that the top 5% of the American population owns more assets than the bottom 81% combined. Goods produced, no matter what their function, are looked at in terms of selling them at a profit. Purchasers are locked into a system of dependence with built-in obsolescence. Products that become a *necessity* in life and that can't be made by the purchasers themselves are considered best. Centralized energy fits into this category, and decentralized solar energy gets only lip service from our rulers. The people themselves are surely intelligent enough to see that solar energy works in their best interest.

A newsclip from June 1981, stated that "in a sharp reduction of the federal government's role in solar energy, the Reagan administration has ordered the dismissal of 370 of the 959 employees at the four-year-old Solar Energy Research Institute at Golden, Colorado, and has fired its director." In addition, the institute's budget was to be cut to $50 million for the next year, which was a 50% reduction. This would reduce spending for outside research. The Reagan administration's "logic" was that most development work should be carried out by private industry—it increased the budget for nuclear power, however. An internal Department of Energy report concluded that American taxpayers have quietly subsidized the private U.S. nuclear industry with almost $40 *billion* over the past 30 years. In reality, nuclear-generated electricity is actually costing Americans two times what the atomic industry claims. So, is it alright for us to subsidize nuclear power, but different when solar power is concerned? The report says that between 1950 and 1979, billions of dollars in federal subsidies went for such things as designing early reactors, getting low-cost fuel to reactors and guaranteeing loans to power plants.

The Energy Research and Development Administration (formerly the Atomic Energy Commission) says "solar energy falling on about 3% of land, if utilized at about 10% efficiency, could meet the total projected U.S. energy requirements for the year 2000."

The big hurdle in promoting solar energy is getting the public enlightened. Changes must really be made on a *worldwide* basis in order to be effective, because the biosphere is like one big aquarium—we have seen how pollution affects *everyone*. We who are already enlightened about pure diets based on living food, and using alternative, renewable energy sources, should reach out to others and share the knowledge.

8. Other Renewable Energy Sources

8.1 Water Power

We've all seen destruction caused by floods, erosion, and the energy of water in the sea waves, and swift rivers and streams. Water power also has a great capacity for useful work. Water power is essentially a form of solar energy, because the sun begins the hydrologic cycle by evaporating water from lakes and oceans and then heating the air. The hot air then rises over the water, carrying moisture with it to the land. The cycle continues when the water falls as precipitation onto the land, then it starts over again.

Water is relatively easy to control and produces a high efficiency, because from 80% to 90% of water energy can usually be converted to work, compared with 25-45% efficiency for solar, chemical, and

thermal energy systems. For this reason many rivers have been dammed so that waterwheels and water turbines could capture the energy of water.

Individuals and communities can harness this energy to produce power in small hydroplants. The dam increases the reliability and power available from the stream, and is a means for regulating the water flow and depth. People should be aware that a dam changes the local ecosystem, though, and should only do so conscientiously.

Water turbines can produce either direct current (D.C.) or alternating current (A.C.) electricity. The power available will not always supply the total amount desired, so it is useful to think of an integrated power systems approach from the beginning, and combine this with another renewable power source.

8.2 Wind Power

Wind is another form of energy created by, the sun—the heating of our atmosphere during the day and its absence cooling the night sky—like the earth is *breathing*. Wind is the reaction of our atmosphere to the incoming energy from the sun—heat causes low-pressure areas and the lack of heat results in high-pressure areas, causing the wind.

The wind is probably the oldest and most constant energy source, probably one of the first sources harnessed by man, and now it's being rediscovered as "new."

Wind energy is not as constant and predictable as the sun and water, but there are also solutions to this problem. Usually a *storage* system is installed that is designed to have the energy available when it is needed. The selection of the site for wind power is very important—for example, it shouldn't be placed near trees that are growing taller, etc. Other factors should be considered on a basis of *frequency* and *intensity*: rain, freezing temperatures, icing, sleet, hail, sandstorms, or lightning.

Windmills have been known for centuries. Even Persia had a primitive horizontal windmill in the tenth century that was used to grind corn. Mills were commonly used in China for irrigation. Modern wind generators not only use the wind for mechanical energy, but also convert the energy into electricity. Wind water pumpers are also available. Most generators consist of the tower, devices to regulate the generator or voltage, the propeller and hub system, the tail vane, a storage system to store power during windless days, and an inverter that converts the stored D.C. into regulated A.C. if it is required. There is often an optional backup system (such as a gas or diesel generator) to provide power through extremely long calm periods. Even better, of course, would be a solar backup system.

8.3 Biofuels

Biofuels are renewable energy sources from living things. Fossil fuels are also of biological origin, but they are *nonrenewable*. All biofuels are derived from plants, which capture the sun's energy, convert it to chemical energy by photosynthesis, and in the process of-being eaten or decayed, they pass this energy onto the rest of the living world. In this sense, all forms of life, and their byproducts and wastes are storehouses of solar energy.

Every day, over 200 times more energy from the sun falls on our planet than is used by the U.S. in a *year*. About half this energy is reflected back into space, and what does penetrate the atmosphere charges all our energy systems.

All plant matter is called *biomass*. Microbes, plants, trees, animals, vegetable oils, animal fats, manure garbage, and fossil fuels are all forms of biomass energy that can be produced, cultivated, or converted in different ways for our needs. All we need to do is use it. Each year the U.S. produces over 870 million dry tons, of discarded organic matter.

Agriculture is the means by which solar energy becomes our food energy, and organic farming techniques and a realization that planting fruit trees is a *priority* in attaining higher quality of life for

humans are the goals we should be pursuing. Please refer to the lessons on organic gardening and tree crop agriculture for more information.

When organic material decays it yields useful byproducts, depending on the conditions under which decay takes place—it can be aerobic (with oxygen) or anaerobic (without oxygen). Any kind of organic matter can be broken down either way, the end products of each will be different. If we imitate the natural anaerobic process and put manure and vegetable matter into insulated, air-tight containers called *digesters*, biogas or methane can be produced.

Another source of energy is *alcohol* in its pure form, which can be used for heating, cooking, lighting, and motor fuel. It is high energy and clean burning. There are two types of alcohol: ethyl alcohol (ethanol or grain alcohol) and methyl alcohol (methanol or wood alcohol). Ethanol can be produced from carbohydrates (starches, sugars, cellulose) found in various farm products such as sugar beets, sugar cane, molasses, fruits, starch crops, grains, etc. Methanol can be produced from wood, sawdust, farm wastes, and urban refuse.

Wood is a renewable energy source that should be used with a conscientious replanting plan, and can be used to supplement other renewable energy systems. (A word of caution: even though wood fires are considered "natural" or "romantic," they put carcinogenic agents into the air. In fact, efficient, slow-burning stoves pose a bigger hazard than roaring flames, since they produce more polycyclic organic compounds (POMs, linked to lung cancer).

We need to learn how to integrate the heat from solar energy, the mechanical power from wind and water energy, and the chemical energy from biofuels, in order to get as much continuous energy as possible from the diverse energy sources.

9. Questions & Answers

A lot of people are talking about underground homes nowadays. What's the story on this?

> An "underground house" above ground can be had with a sod roof—the earth covering acts as a moisture barrier and insulates the roof. Actually, nowadays people are discovering that underground houses are very comfortable. In hot and cold climates, weather isn't as extreme underground, and the homes aren't dark, damp, or dismal either, which might be our first impression when thinking about living below the ground. Many homes are built with a regular south wall with windows, and the rest under the ground. In either case, skylights can provide lighting. Less heating or cooling needs to be done in an underground home, so energy is conserved, and underground buildings are quiet and blend nicely with their environment, leaving nature virtually untouched.
>
> There is a subdesertic region of Turkey, Cappadocia, where people have been living in underground towns and cities since the years B.C. in settlements, some of which extend eight or ten stories below ground. They are hewn out of the soft stone common to the area. The climate there is comfortable despite harsh variations of heat and cold on the surface. There are even some "luxury" caves in France's Loire Valley where some caverns were furnished and carpeted and sold to wealthy city dwellers who appreciate the coolness in summer and natural winter warmth.
>
> Underground homes don't need to be painted, roofs don't need to be replaced, pipes don't

freeze, and they have a low-cost construction.

What is the effect of radiation in the gene pool?

For people still in their reproductive years, whether male or female, injury can occur either to the sperm-generating cells in the testes or the ovum-generating cells in the ovary, and injury to the genes there can cause hereditary changes or disease or death in generations for many generations beyond the irradiated individuals.

What about the effect of radiation on a developing fetus?

Radiation injures the genetic material that is guiding the cells in a developing fetus to form the various organs and tissues. Evidence indicates that the developing fetus is more sensitive to ionizing radiation in terms of the effects caused than children are, and children in turn are more sensitive than adults. (In fact, the fetus is even more sensitive to radiation in the *first* trimester of pregnancy than in the third.)

Article #1: Truths About X Rays by Virginia Vetrano

Television radiation is an addition to background radiation, fallout, luminous dial watches, radiation from medical and dental X rays, fluoroscopy, and radiation from fluorescent lights, under which most workers have to work. These sources must be added, not compared, because it is the way it works in the living organism. All radiation is cumulative, that is, it is additive, one dose is added to another, and so even if one would appear unharmed by X rays, the cell never seems to recover completely. The least amount of radiation absorbed in living tissue produces damage.

It has been known for a number of years that X rays produce cataracts. The lens of the eye is extremely sensitive to radiation and is irreversibly damaged by ionizing rays.

The cell is capable of preventing most drugs from entering and combining with it, thereby killing it. But the cell has no defense against the onslaught of X rays. At high speed they penetrate the cell like bullets and damage enzymes and enzyme systems, disrupt proteins, genes, fats, and other large molecules, impair some metabolic processes and completely block others. Irreparable damage is done so quickly that defense is impossible. There remains only cellular confusion with feeble attempts at repair.

Article #2: No Permissible Radiation Level by Virginia Vetrano

At the Atom Bomb Hospital in Hiroshima, survivors of the August 6, 1945, holocaust are still dying at the rate of four to six a month. Even this figure does not represent the total death rate, for there are other hospitals, and not everyone patronizes hospitals in the first place. The paper from which I received the

above figures says: "After years of study, world scientists are still unable to agree just how lethal the latent after-effects of exposure to an atomic bomb can be." The scientists don't wish to admit that every one of the victims will die ultimately, from the latent effects of exposure to radiation. Instead of an instant death these survivors will suffer long years of miserable sickness until finally, after a continuous struggle to repair damaged tissue, the organism will succumb to the deteriorating forces.

It is well-known that all radiation, however small it may be, shortens one's life. Hence, all radiation is lethal. Watch for equivocal and ambiguous scientific cant and you will be amazed at their unequivocal dishonesty.

All talk of protection against atomic radiation, of bomb-proof shelters, etc., is based on wishful thinking. Eventually one will have to come out of the shelter to eat, drink and breathe, and consequently be exposed to the excessive radiation still in the air, food, and water. Hence, one is thus subjected to the process of a slow and painful death. There is but one possible protection and this is the immediate cessation of all nuclear explosions. Dr. Shelton says of this, "As our world is a lunatic asylum controlled by the worst elements of our population, it is doubtful that this will be done." However, we must still try.

But we have to be educated into understanding the double talk of the hired scientists before we can realize that damage is being done from all these nuclear bomb tests, which eventually, may lead to another nuclear holocaust. The tests themselves are contaminating the earth and causing many lethal illnesses. The hired scientists cover up the facts by saying that there will not be any "statistically significant" deaths from these tests. To these scientists we are looked upon as *so many guinea pigs*, so if 1,000,000 guinea pigs should die in a population of say, 180,000,000, that is statistically insignificant. Do you feel statistically insignificant?

To continue bomb testing, the Atomic Energy Commission (AEC) had to rationalize their actions. It is their attitude that, so long as we can't observe the persons being harmed with our own eyes, then they can continue testing and permit the fallout level to rise just that much and the masses won't rebel.

The "permissible" level of radioactivity to be absorbed by the population as a whole is based on the ideas discussed above. Many well-informed persons have stated that the true facts are *not* disclosed to the general public.

Reassuring statements regarding fallout hazards are always preferred by the majority, hence they close their ears to anyone telling the truth about these matters and label them "alarmists." To the statement that fallout is definitely doing damage to the genetic pool as well as to somatic tissue, they retort exactly what has been brainwashed into them: "That the radiation from fallout is not more than what we have, all through the years, been accustomed to from natural background radiation." These people are fooled by such statements. They are not thinking for themselves, or they would realize that fallout is, in addition to background radiation, augmenting the dosage which we habitually receive as the radioactive fallout increases. A book which contains many selected reviews by AEC scientists reads: "As more and more experience with X rays and gamma rays has accumulated, however, the concept of 'tolerance dose' has changed somewhat to the thought that there is no such thing as a literally harmless dose of radiation —that any amount, however small, does some damage."

Moreover, many experiments involving radiation have been made on rats, and it has been proved that man is *more susceptible* to radiation than the rat.

Scientists know now that the least possible amount of radiation does cause various diseases, but this does not make them stop the arm's race. Why? Obviously, since the United States is vulnerable to an economic collapse as a result of a sharp decline in arms production, so tests and weapons production will continue as a means of saving our tottering capitalism.

An important thing which we must not overlook when evaluating the "permissible" dose of radiation is that it disregards completely the hereditary damage done to our genetic pool.

Article #3: To Mutate or Not to Mutate by Virginia Vetrano

The result of the Manhattan Project, an experiment to determine the effects of radiation, are very terrifying. The Manhattan Project was top secret but some scientists were permitted to view the experimental animals at various stages because it was the project that developed the first atom bomb dropped on Hiroshima.

Groups of mice were exposed to gamma rays from the experimental piles, each succeeding group receiving double the dose of radiation of its predecessor, until a point was reached where the mice were being obviously burned. The mice were kept and the developments recorded over the next several months. All except the first three groups were dead or showed signs of lethal damage at the end of a few weeks, leaving no progeny. After being watched for a month or two the "undamaged" mice were set aside for other experiments—that is, they were treated as new stock and all seemed to go well until the next generation.

Then a startling discovery was made. Many abnormalities and "mutation" showed up. A higher and higher percentage of the mice exhibited degenerative changes and deformity each generation. Although, in almost all cases, the deviation from normal was accompanied by sterility, this was not always so. Then some of the slightly deformed mice produced larger and better looking mice than usual.

All of these mice, large and small, degenerate and deformed, were allowed to breed and in the fifteenth generation, all had warped and distorted limbs and bodies, and what was even more noticeable, queer behavior and unreliable temperaments. Stillbirths were increasing and greater numbers of the survivors were sterile and suffered from nonhealing sores or cancers. From the twenty-first to the twenty-fifth generations all had become cancerous imbeciles, unable to feed themselves. Handfed, a few survived to produce a twenty-ninth generation, but these mice were paralyzed and brain cells were growing on the outside of the skulls.

All of this happened to mice that were by all appearance and by all tests completely undamaged by the radiation. Is this evidence that mutations, like somatic damages, can develop latently as I suggested in the first part of the article? But this was not all, many of the offspring of these mice were born albinos and many were born blind, than after the seventh generation not only were they born blind, but many were born without eyes at all and many did not grow any bones, apparently because the bonegrowing genes had been omitted, and their skulls and teeth did not grow. Beginning with the twentieth generation the brain protruded unprotected and exposed to the open air. There were many monstrous developments, such as young born growing together, twins were born with only parts of their bodies separated. Many of that generation were born with what the investigators call the "death gene," which means that their progeny were completely sterile, which is, perhaps, the best solution to a condition so abnormal.

According to the Public Health Service Report, man is more susceptible than the mouse and logically an experiment made on mice would be magnified in man.

If human "mutations" develop at the same rate as those observed in the mice, we must wait up to 250 years, to know that we have come through the present spread of radiation over the earth, while, to develop the worst effects from present day exposure we must wait 400 to 600 years.

The gonads are integral parts of the body and are fed by the same bloodstream that feeds all other parts of the body. Experiments with radioactive isotopes prove conclusively that radioactive substances are carried by the bloodstream to all parts of the body. It is certain that radioactive materials, such as strontium 90, are carried to the gonads where they reach the hereditary units carried in these glands. What effect does this have on the chromosomes and genes? Is it as destructive to the germinal material as to the bones and other tissues? Will its presence, even in minute amounts, result in the production of mutations? If so, what kind of mutations may we expect?

Radiation escaping from industrial plants so constitutes a menace, not only to workers in these plants, but to the populations living within the contaminated areas. George Truman, vice-chairman of the Chemical Worker's Union, said in a speech before the conference on Industrial Health, in Manchester, England, in 1955, that men at the atomic works were sterilized by the radiation to which they were subjected. The same thing has been found to result to the men working at Oak Ridge in this country. It is obvious that scientists, militarists and manufacturers, who plan to make use of atomic power in industry, are playing with a dangerous fire that may ultimately extinguish the whole human race, even without the occurrence of an atomic war. The plain fact is that nobody knows how to bypass the unspeakable biological debasement which always follows any widespread increase in nuclear radiation.

Due to the fact that certain tissues tend to concentrate particular chemical elements, sometimes to tens of thousands of times that present in the surroundings, even though only traces of radioactive substance may be present in the water from an atomic power station, plants growing in the water or air may absorb and store the substance until a really high concentration is built up. Animals eating these plants will receive and suffer from radiation. The Japanese found, to their horror, that it takes a surprisingly short time for fish to eat slightly contaminated smaller forms to become themselves highly radioactive.

Most all the inhabitants of the earth are receiving minute, but *cumulative* doses of radioactivity and all future testing of atomic hydrogen and cobalt bombs will increase the danger to human, animal, and plant existence.

When in April of 1958 Dr. Linus Pauling called attention to the radioactive menace of carbon 14, which results from nuclear explosions, his statements were hooted at the subsidized scientists of the Atomic Energy Commission, who said that his statements were exaggerated and they accused him of irresponsibility. He had said, among other things, that the radiocarbon from thirty megatons of fission "will ultimately be responsible for the birth of 230,000 defective children and also 430,000 embryonic and neonatal deaths."

The scientists of the AEC have since eaten their words. A document titled, "The Biological Hazard to Man of Carbon 14 From Nuclear Weapons," has sustained Pauling's estimates. Dr. Ralph E. Lapp, of the commission, says that Dr. I. Leipunsky, also of the AEC, concludes that "bomb carbon 14 as of 1960 may ultimately involve 100,000 cases of gross physical and mental defects, 380,000 cases of stillbirths and childhood deaths and 900,000 cases of embryonic and neonatal deaths. Dr. Pauling's previous estimate was based on thirty megatons, which were about half the megatons exploded up the summer of 1958. His estimates are quite close to those of the AEC. Lapp adds: "Absolute numbers, such as those cited for carbon 14 genetic damage are impressive, especially when they apply to the 266 future generations covered by the persistence of carbon 14s long life (average life of 8,000 years").

I would substitute the word *frightening* for the word impressive in this last statement. The fact is that today, nobody—physician, physicist, biologist, or geneticist, knows the long-term, ultimate effects of radiation. The study of these effects is only in its infancy and there remains much yet to be learned. Indeed, there is reason to think that there is much already known that has not been made public.

It is noteworthy that from the outset of the study of radioactive damages, there has been a repeated downward revision of the maximum permissible dose. Looking back, it is obvious that our scientists have constantly underestimated the hazard. The permissible dose of 1931 was reduced by half in 1936 and then to less than half again in 1950. By 1957 the figure had been reduced to less than a third of the 1950 dosage. This is a total reduction to one-fifteenth of the 1930 dosage. It is now generally thought that that there is no threshold dosage, as I have mentioned before. Commenting upon this steady-lowering of the permitted maximum dose, Dr. L. S. Taylor, of the U.S. Bureau of Standards, said: "It will be extremely difficult to lower the standards further and still permit the effective use of radiation in medicine, industry and research."

A luminous dial wrist watch worn twenty-four hours a day would give the central body including the sex organs a dose of about 40 mr/year. Airplane pilots also receive a considerable dosage per year from luminous instrument panels. It seems that every modern invention is fraught with danger, and the only

intelligent thing to do is to scrap the so-called "modern conveniences" (the harmful ones) if we wish to preserve the human race in some intelligible form.

Article #4: A New Pathway to Extinction by Virginia Vetrano

The only way to stop the threat of an atomic war is to ban the use of all nuclear weapons and cease manufacturing fission products by the use of atomic power plants. Power plants are contributing heavily to the pollution of our streams, rivers, seas, and our atmosphere. If this rate of pollution continues, soon there will be no food, no water, or air which is safe to eat, drink, and breathe respectively. We are destroying our planet and working for the extinction of mankind. We must stop all nuclear explosions and all atomic power plants. There is no need to be cowards and let ourselves be pushed around from now to eternity, which won't be far off if this testing of nuclear weapons is not stopped and atomic power plants abolished.

With increased bomb testing, we have nothing to look forward to but showers of invisible radioactive dust pouring down upon us and penetrating out bodies by means of our air, food, and water for the next five to seven years or more. The most ominous threat, however, is to our children. They are the ones who will reap most of the harvest of this madness called "preparedness for peace," and the younger the child the more sensitive and more easily damaged are his cells from radiation.

Dr. Linus Pauling most forcibly says, "The only safe amount of strontium 90 in the bones of children is zero." Unfortunately atom and hydrogen bombs never yield this safe amount. He further emphasizes that if testing of atomic bombs continues, about 100,000 children of the next generation in the United States will die. He also stated, and this was before the French tests in the Sahara, that "these bomb tests will also cause the birth of 200,000 seriously defective children in the next generation of human beings, children with serious mental deficiency or serious physical defects."

Can we afford to "relax and enjoy life" when the very essence of life is being destroyed? The pool of human germ plasm is being greatly damaged, our mental capacities are diminishing, our physical capacities deteriorating and yet we do nothing. A national revolt is no longer adequate; what we need is a world revolt. Billions of yet unborn children will come into this world with diminished mental capacities and serious physical defects *because we, the thinking portion of the population, have not made ourselves* heard. It is we who are to blame for this gross crime committed against the future human race. In the history of the United States, no unwanted thing continued to exist when the whole population stood together and rebelled. Unfortunately, rebellion and singularity seems to have been knocked out of all Americans.

We must unite to fight every profession using X rays for diagnosis and therapy, we must fight the Atomic Energy Commission and every other nation which desires to enter in the atomic race. Every source of damage to our children and future children must be abolished less we perish from this earth. We must expect much strong opposition from all these sources because not only are their bread and butter in jeopardy but also their diamonds, fur coats, and Cadillacs.

Furthermore, this class of people won't stop their damaging practices unless they are forced to do so, as is evidenced by the cumulated facts before us. Despite the fact that scientists have predicted the strontium 90 content in Japan would be beyond the AEC safety limit by 1962, and that in 1959 stillborn babies of Southern Japan were being found with the Sr 90 content already exceeding the so-called "safe limit," nations continue to clamor for more testing of atomic and hydrogen bombs. Other evidence that force is necessary to stop these damaging influences is the fact that the x-raying of pregnant women has

been continued well into the present time, although for years it has been known that exposing a fetus or an embryo, even momentarily, to X rays could cause cancer in early childhood.

Even authorities, such as Schubert and Lapp are disturbed over what they call "our irradiated children." They say "thousands of infants and children in the United States are needlessly exposed to more radiation in one year than would be allowed atomic energy workers in a lifetime." They were speaking of medical and dental sources of X rays, which is another thing the AEC overlooks when planning on contaminating the air with more fallout; the fact that our population as a whole is already over irradiated from medical and dental uses of X rays only more aggravates the hurt. Our responsibility is to protect our children from these unnecessary and inimical sources of radiation. Fortunately, it is still within our power to refuse medical and dental X rays, although we are still helpless under the blanket of fallout blasted into the air by our "mad scientists."

Rapidly dividing cells, as seen in embryos, infants, and young children, are more sensitive to all kinds of radiation, i.e., they are more easily damaged. The younger the child, the more likely will he suffer from delayed effects such as cancer and leukemia. A person of advanced age, receiving a dose of radiation, will probably die before cancer has a chance to develop, but if an American boy, with an average life span of 66 years, or a girl with an average life span of 72 years, has been irradiated in the embryonic state or in early infancy, there is more than ample time for him or her to develop cancer or leukemia in early life.

The fact that the young are more sensitive to radiation and that they have many more years to live is reason enough to exclude all sources of radiation from them, but there is another very important reason which we should not overlook. These children will grow up to reproduce their kind and if no more effort on the part of hospitals, physicians, and radiologists is made to shield the germinal elements of these children than has been made in the past, *the human race will be mutated out of existence*. Through surveys made by prominent men, it has been shown over and over again that physicians fail to protect the gonads while x-raying and that even in the best and well-equipped hospitals no effort is made to protect the gonads of children while treating them. The many thousands of articles written to warn physicians of the dangers engendered by failing to protect the gonads of the young are written to no avail as the advice seems not to be heeded. It is still up to the people themselves to stop the practice of irradiating the young altogether.

During the early embyronic stages, from the moment of fertilization to approximately the end of the third month, human cells are most sensitive to radiation. Investigations have shown that even small doses of radiation during this period may lead to malformations and sterility. Just as there are certain stages in cell division (mitosis), in which the cell is more sensitive to radiation, there are also certain stages in embryonic development when organs and organ-systems have an augmented sensitivity to radiation.

Reprinted from Dr. Shelton 's Hygienic Review, July, 1960

Article #5: Solar Energy Will Revolutionize Your Life

How would you like to see your *total direct* energy bill drop from say $1,500 per year to a mere $50 to $75? And your *indirect energy bill*, as represented in the products you buy, drop yet another $ 1,000 or so?

Fantasy?

Absolutely not! The technology is here now, today!

There is a gremlin in the works, however. But we're betting this dark shadow will not be around long. There's too much in favor of this getting into foreign hands, etc.

An inventor and electronics specialist, Stanford R. Ovshinsky of Troy, Michigan, has made the most startling energy breakthrough in all history! In fact it is so revolutionary that all other forms of energy utilization are immediately obsolete! And therein is the rub.

Mr. Ovshinsky developed what he called "ovonic materials" for applications in the computer industry. Imagine how stunned the scientific world was to learn that not only were the materials "dirt cheap" but that they transformed solar energy directly into electricity at a cost of about 1/25 of the cost of such conventional sources as coal, water power, etc., presently our cheapest sources for power.

Can you imagine paying a service station say $5 for a battery power back chance for your car and driving from 500 to 700 miles before having to change packs or, if you have the time, of recharging the battery pack from your own home-owned generator made of ovonic materials? Or of having your own power generator made of ovonic materials right on the roof of the your car?

Can you imagine meeting all your home power needs with a few solar panels located on your roof or wherever you place them such that they capture the sun?

Can you imagine the great grid power system that mars our land with endless lines disappearing?

Can you imagine yourself being free of outside energy needs altogether? Of being an island unto yourself in meeting your energy needs just as you presently meet your needs for air?

The revolution will be so sweeping anything you visualize will probably be far short of the mark.

But the rub? What is that little gremlin we spoke of?

Mr. Ovshinsky went heavily into debt. Help came in the form of monies from two industrial giants who, to all appearances, want to keep ovonic materials AWAY from consumers.

The easy path Mr. Ovshinsky took to free himself of burdens was to sell part interest in his solar devices to, *and get this*, United Nuclear Corporation and Exxon Corporation.

United may well find rescue in the new technology. But Exxon? Do you for a moment think they have anything to gain? Do you think they will let their multibillion dollar investment in oil and coal go down the drain? Do you think they will permit their annual multibillion dollar income to plummet to near nothing by marketing a solar device that practically kicks them out of the energy marketplace?

Much remains to be seen in this case. We're confident that overriding factors even larger than United and Exxon will bring ovonic materials or even better materials to the consumer and relatively soon.

Mr. Ovshinsky must be hailed as having made the most humanitarian invention of this century. And we must push with all our mights as interested parties to see that this invention sees widespread application as soon as technically possible.